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IS 9000-10 (1979): Basic environmental testing procedures for electronic and electrical items, Part 10: Mould growth test (Redesignation of IS:7805-1975) [LITD 1: Environmental Testing Procedure]



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IS : 9000 (Part X) - 1979

Indian Standard

BASIC ENVIRONMENTAL TESTING
PROCEDURES FOR ELECTRONIC AND
ELECTRICAL ITEMS

PART X MOULD GROWTH TEST

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BUREAU OF INDIAN STANDARDS

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NEW DELHI 110002

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART X MOULD GROWTH TEST

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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART X MOULD GROWTH TEST

0. FOREWORD

0.1 This Indian Standard (Part X) was adopted by the Indian Standards Institution on 3 December 1979, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The differences in environmental testing procedures for component type items and equipment type items are fast disappearing in the context of technological developments. It is, therefore, felt necessary to have uniform testing procedures wherever possible. This series of standards on environmental testing procedures (IS : 9000) has been prepared with this objective. This is also in line with the principle adopted by IEC/TC 50 Environmental Testing in developing unified series of standards on environmental testing procedures by International Electrotechnical Commission.

0.2.1 It is proposed to withdraw the existing Indian Standards, namely, IS : 589-1961* and IS : 2106† series dealing with environmental tests for electronic components and equipment respectively, as soon as the tests mentioned therein are covered in the new series (IS : 9000).

0.3 Two types of tests are included in this standard, one, a short exposure (28 days) to assess the extent of mould growth and the other, a much longer one (84 days) to assess the effect of mould growth on the functioning of the item. The applicability of either of the procedures should be specified in the relevant specification.

0.4 When an item is expected to operate in regions where it will be exposed to wind-borne mould spores and where climatic conditions will be conducive to the growth of mould, the test procedure described in this

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (revised).

†Environmental tests for electronic and electrical equipment.

IS : 9000 (Part X) - 1979

standard may be used to assess the extent to which mould will grow and the operational deterioration which may be expected from this source. It is advisable to use established mycological testing procedures to assess the vulnerability to damage by mould contamination of the constructional materials used, and to use only materials which are free from serious attack. The test procedure covered in this standard is intended only to investigate the unforeseen sources of trouble in assembled items which have been constructed from materials already found to be generally suitable for use in the presence of mould contamination.

0.5 Items which are not intended to be operated where there is exposure to mould spores, may have to be stored or transported where a temporary exposure is experienced and in these cases also, the test procedure will be found useful. In case an item is protected from such exposure, even though operating in a region where mould spores are abundant, ability to withstand higher severity of this test is not considered necessary.

0.6 Due to the difficulty of maintaining the necessary conditions in a very large chamber, a large composite equipment will normally be tested as a number of sub-units. This will, in any case, minimize the cost of the test, since several sub-units may be of such similar construction that only one of them need be tested.

0.7 The mould cultures mentioned in this standard should be obtained from Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur.

0.8 This standard is largely based on IEC Publication 68-2-10 (1968) 'Basic environmental testing procedures for electronic components and electronic equipment, Part 2 Tests — Test J : Mould growth' issued by the International Electrotechnical Commission.

0.9 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part X) gives details of the procedure for application of mould growth test on electronic and electrical items.

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of the terms given in IS : 9000 (Part I)-1977* shall apply.

3. OBJECT

3.1 The object of this test is to assess:

- a) the extent of mould growth by a short exposure, Severity 1 [see 5.1(a)], or
- b) the effect of mould growth on the functioning of the items by a longer exposure, Severity 2 [see 5.1(b)].

4. DESCRIPTION OF TEST CHAMBER

4.1 The chamber shall conform to the requirements of IS : 9002 (Part IV) - 1979†. The temperature of the chamber shall be between 28 and 30°C and the relative humidity at a value greater than 90 percent. Small items could be exposed directly in this chamber or in containers as described in 4.4.

4.2 The door of the chamber shall be opened for a few minutes once a week to renew the oxygen supply within it, and to add further water to the slurry.

4.3 If the chamber becomes contaminated, it is desirable to clean it. The preferred method is to heat it in a moisture saturated atmosphere at 120°C for 1 hour. When heating cannot be tolerated, an alternative method is to dry it and fumigate it with propylene oxide, washing it with water containing a detergent and ventilating it well to remove all oxide fumes.

4.4 For Small Items

4.4.1 The chamber used for testing small items shall be capable of maintaining its working space at a temperature between 28 and 30°C.

4.4.2 Any periodic cycling of the temperature due to action of the thermostat shall not exceed 1°C per hour.

4.4.3 Each group of test items and control strips shall be contained within one or more glass or plastic containers (such as petri dishes) with

*Basic environmental testing procedures for electronic and electrical items : Part I General.

†Specification for equipment for environmental tests for electronic and electrical items: Part IV Chamber for mould growth test.

IS : 9000 (Part X) - 1979

close fitting lids. These containers shall be placed in the chamber (*see* 4.4.1) for maintaining suitable test temperature.

4.4.4 The container shall have free water exposed at all times in the base to maintain a relative humidity within it which is greater than 90 percent. The test item shall not be allowed to rest in this water or to be splashed by it.

4.4.5 The lid of the container shall be removed for a few seconds once a week to ensure a regular supply of fresh oxygen to the growing moulds.

4.4.6 If the chamber or a container becomes contaminated, it is desirable to clean the same (*see* 4.3).

5. SEVERITIES

5.1 The severities shall be specified in the relevant specification. The values shall be selected from those given below:

- a) Severity 1 (to check extent of mould growth) 28 days
- b) Severity 2 (to check damage arising from mould growth) 84 days

6. CULTURES

6.1 List of Cultures — The following mould cultures shall be used for performing this test. The nature of attack from each culture is indicated for guidance, but all spores shall be used together, whatever be the nature of item.

<i>Sl No.</i>	<i>Name</i>	<i>Strain</i>	<i>Nature of Attack</i>
i)	<i>Aspergillus niger</i>	V. Tieghem	Grows profusely on many materials and is resistant to copper salts
ii)	<i>Aspergillus terreus</i>	Thom.	Attacks plastic materials
iii)	<i>Aureobasidium pullulans</i>	(De Barry) Arnaud	Attacks paints and lacquers
iv)	<i>Paecilomyces varioti</i>	Bainier	Attacks plastics and leather
v)	<i>Penicillium funicolosum</i>	Thom.	Attacks many materials especially textiles
vi)	<i>Penicillium ochrochloron</i>	Biourge	Resistant to copper salts and attacks plastics and textiles
vii)	<i>Scopulariopsis brevicaulis</i>	(Sacc.) Bain Var. Glabra Thom.	Attacks rubber
viii)	<i>Trichoderma viride</i>	Pers. Ex. Fr.	Attacks cellulose textiles and plastics

NOTE — The cultures given in Appendix A may also be used at the discretion of designer, user or manufacturer.

6.1.1 The culture shall be supplied as spores, on an agar medium in glass containers with cotton plugs, or as otherwise considered appropriate by the mycological institute supplying them.

6.1.2 The cultures should be stored in a refrigerator at a temperature between 5°C and 10°C. The cultures should be used for preparing the test suspension when they are between 14 days and 21 days old. The stoppers shall not be removed until the mould suspension is about to be made and only one suspension shall be made from the opened container. A fresh, unopened container shall be used for each batch of suspension.

6.2 Preparation of Mould Suspensions

6.2.1 The mould suspension shall be prepared in distilled water to which has been added 0.05 percent of a non-fungicidal wetting agent. An agent based on N-methyl tauride (igepon) or on dioctyl sodium sulphosuccinate shall be suitable.

6.2.2 Ten millilitres of the water and the required wetting agent are added gently to each phial or tube. A platinum or a nichrome wire is sterilized by heating to red heat in a flame and allowing to cool. This wire is then used to scrape gently the surface of the culture to liberate the spores. The liquid is gently agitated to disperse the spores without detaching mycelial fragments and the mould suspension gently decanted into a flask.

6.2.3 All the eight dispersions are shaken vigorously together in the flask to mix thoroughly and to break up any clumps of spores.

6.2.4 The suspension shall be used on the same day during which it is prepared and shall not be stored for future use.

6.3 Control Strips

6.3.1 The control strips shall consist of strips of pure white filter paper soaked with nutrient salts solution described in **6.3.2**.

6.3.2 The nutrient salts solution shall consist of the following chemically pure materials:

Potassium dihydrogen orthophosphate (KH_2PO_4)	0.7 g
Potassium monohydrogen orthophosphate (K_2HPO_4)	0.3 g
Magnesium sulphate ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$)	0.5 g
Sodium nitrate (NaNO_3)	2.0 g
Potassium chloride (KCl)	0.5 g
Ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)	0.01 g
Sucrose	30 g

IS : 9000 (Part X) - 1979

6.3.3 The quantities mentioned above are the amounts required for a litre of distilled water. The strips shall be placed in a small glass dish and covered with nutrient salts solution. The strips shall be removed from this solution and allowed to drain free of drips immediately before use.

6.3.4 The strips shall be freshly prepared on the same day in which they will be used for the test.

6.3.5 A freshly prepared nutrient salts solution shall be used for preparing each batch of control strips.

6.4 Condition of Cultures

6.4.1 Cultures should be obtained from an official mould research station (*see 0.7*).

6.4.2 Owing to the large number of generations in the genetic history of the standard cultures, it is possible for them to suffer variations in their ability to attack certain materials. The assessment of this ability requires a high degree of mycological skill, and the research station supplying these cultures for test purposes should ensure that they are as suitable for this test procedure as those previously supplied and considered acceptable.

7. INITIAL MEASUREMENTS

7.1 The items shall be in the condition in which they are normally supplied for use. They shall not receive any special cleaning treatment.

NOTE 1 — Where prescribed by the relevant specification, it is permissible to clean half of the items in ethanol or in water containing a detergent before testing, so that mould growth caused by the use of unsuitable materials can be distinguished from that due to surface contamination.

NOTE 2 — *See* Appendix B for the effects of fungicidal varnishes.

7.2 The items shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

8. CONDITIONING

8.1 The relevant specification shall prescribe whether only a visual examination of mould growth is required or whether the exposure is to be followed by measurements to determine deterioration resulting from mould growth.

8.2 When only visual examination is required, only one group of items is required. When measurements are required after exposure, two groups of items will be required, one to be exposed only to humidity and the other to humidity with mould spores present.

8.3 One group of items shall be sprayed with the mixed spore suspension in water. The spray shall be generated by a nozzle large enough not to be blocked by fragments of mycelium, such as an artist's spray gun, and shall impinge on all surfaces of the items.

8.4 If measurements are called for, and, in consequence, there is a second group of items, it shall be similarly sprayed, but with water containing wetting agent only and no spores.

8.5 Three control strips shall be sprayed with the same spore suspension used for the items, and exposed at the same time, and in the same chamber, as the items.

8.6 In the case of small items, the items and the three control strips shall be placed within individual containers and exposed in the same chamber.

8.7 In the case of large items the three control strips shall be exposed in the same chamber as the items sprayed with spore suspensions and if there is a second group of items sprayed with water only, it shall either be exposed in a second chamber or in the same chamber cleansed as in 4.3 sequentially with the other group.

8.8 The items and control strips shall be placed inside the chamber within 15 minutes of spraying and shall not be unduly disturbed, except for opening the chamber door each week, until completion of the exposure period.

8.9 If no mould growth is visible on any of the control strips when first opened 7 days after spraying, the test shall be considered void and shall be recommended.

8.10 Providing that mould growth on the control strips indicates that the conditions are suitable and the moulds viable, the items shall be exposed continuously for 28 days, if only visual examination is required; and for 84 days or such other period as the relevant specification may state, if measurements after exposure are required.

9. RECOVERY

9.1 When the specification calls for measurements after recovery (see 10.2), items shall be removed from the container or chamber and

exposed to standard atmospheric conditions for recovery for a period of 24 hours, at the conclusion of which the measurements shall be made.

10. FINAL MEASUREMENTS

10.1 Visual Examination

10.1.1 When the specification calls for only a visual examination of mould growth, the items shall be removed from the chamber after 28 days exposure and examined under a magnification of 50 ×. As soon as a growth is exposed to the drier atmosphere of the laboratory it will begin to dry. Microscopic examination and photography, if any, shall therefore, be carried out quickly.

10.1.2 Following a visual examination and assessment of the actual growth, the myceliae shall be carefully washed from the surface and the surface shall be examined through a microscope to assess the nature of any physical attack or etching on the items.

10.2 Effect of Growth

10.2.1 When the specification calls for measurements while damp, following exposure, it is essential that the humidity surrounding the item shall not be allowed to fall unduly until after such measurements have been made. Such measurements shall therefore be carried out for small items in the container with the lid still fitted, and free water still exposed, and for large items while they are still in the chamber.

10.2.2 When the specification calls for measurements after recovery, these shall follow the procedure in **9.1**.

10.2.3 Similar measurements shall be made on the items sprayed with spore suspensions and those sprayed with water only. Any significant difference between the two groups is considered to be additional deterioration due to the presence of mould growth in the presence of high humidity.

10.2.4 Following the measurements, the items shall be removed and visually examined as in **10.1.1** and, finally, any attack on the item determined as in **10.1.2**.

10.3 Extent of Growth — The extent of mould growth (*see* **10.1.2** and **10.2.2**) shall be assessed and expressed according to the following scale:

No growth apparent under a magnification of 50×	0
Fungus growth hardly visible to the naked eye, but quite apparent under a magnification of 50×	1
Growth plainly visible to the naked eye, but covers less than 25 percent of the test surface	2
Growth plainly visible and covering more than 25 percent of the test surface	3

11. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

11.1 When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

- a) Type of cultures employed (*see 6.1*);
- b) Whether visual inspection only is required, and test may be terminated after 28 days or whether the test is to be continued for 84 days (*see 8.1*);
- c) Extent of mould growth allowable, and any special requirements regarding etching of surfaces (*see 10.3*);
- d) Measurements and mechanical checks prior to conditioning, only if performance deterioration is to be determined (*see 7.2*);
- e) Period of exposure if this is not the standard 28 days without measurements or 84 days with measurements (*see 5.1*);
- f) Measurements and mechanical checks after exposure, only if performance deterioration is to be determined (*see 10.2*);
- g) Whether measurements and mechanical checks after exposure, where they are required, are to be made while damp, or after recovery, or in both conditions (*see 9, 10.2.1*); and
- h) Any variation from the standard procedure which may be desirable due to special nature of the item.

APPENDIX A

(Clause 6.1)

ALTERNATE LIST OF CULTURES

A-1. For performing the test, the following cultures, in place of those specified in **6.1**, may be used at the discretion of designer, user or manufacturer:

<i>Sl No.</i>	<i>Culture</i>	<i>DMSRDE* Number</i>	<i>Basic Materials Attacked</i>
i)	<i>Aspergillus amstelodami</i>	144	Cotton, Jute, Lignin, Leather
ii)	<i>Aspergillus niger</i>	871	Cellulose, Textiles, Waxy coatings, Silk, Bakelite, PVC, Mica, Bitumen, Alkathene, Alfoil and host of other materials
iii)	<i>Aspergillus versicolor</i>	1 002	Paints, Lacquers, Leather, Plastics, Rubber
iv)	<i>Chaetomium globosum</i>	980	Cellulose, Copper and Mercury salts, Lignin, Aluminium, Textiles
v)	<i>Cladosporium herbarum</i>	875	Rubber, Silk, PVC, Cellulose, Hylam, Hydrocarbon based products, etc
vi)	<i>Paecilomyces Sp</i>	529	Leather, Paints, Lacquers, Plastic materials, Aluminium, Laminates
vii)	<i>Penicillium brevicompactum</i>	855	Aluminium foil, Casing paper, Waxed paper, Mica
viii)	<i>Penicillium funiculosm</i>	844	Textiles, Flax, Jute, Rubberised fabrics, Rubber
ix)	<i>Stachybotrys atra</i>	168	Silk, Rubber, Cellulose, Plastic materials

*Defence Materials and Stores Research and Development Establishment, Kanpur.

APPENDIX B

(Clause 7.1)

FUNGICIDAL VARNISHES

B-1. It is the practice, in the manufacture of some electronic components or equipments, to coat the item with a varnish containing a fungicide.

B-2. Such a varnish coating will only give protection for a limited period. Such fungicides function only because they are volatile substances, and while some will give extreme protection for a few months; others will give fair protection for one or more years. The period of protection will be shorter if the item operates at high temperature than if it is always cool.

B-3. Even where the fungicide gives a prolonged protection, there is a tendency for evolutionary variation to produce, in time, a selection of moulds which are resistant to the fungicide.

B-4. Where a fungicidal varnish is applied to give temporary protection only, it is suggested that this test be performed on the items so treated.

B-5. Where items are expected to function for several years in conditions of continual exposure to mould spores, it is suggested that the items be tested coated with an identical varnish formulation which does not contain the fungicide.

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